DISTRIBUTION AND ABUNDANCE OF JUVENILE COHO AND STEELHEAD IN GAZOS, WADDELL AND SCOTT CREEKS IN 2002

Jerry J. Smith
Department of Biological Sciences
San Jose State University
San Jose, CA 95192
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ABSTRACT: In September and October 2002 previously sampled representative sites on Gazos Creek and Waddell Creek and in the Scott Creek watershed were evaluated for habitat conditions and sampled by electrofisher to assess distribution and abundance of steelhead and 2002 year class coho. Juvenile coho on Scott Creek were present at all sampled sites, and overall density (79.2 fish per 100 feet) was 2 ½ times that of 1993, 1996 and 1999 (27.2-33.0). Scott Creek coho were smaller than in previous high abundance years, apparently due to intense intraspecific competition. Juvenile coho on Waddell Creek were found at 2/3 of sampled sites, but most fish were found on the West Fork. Overall density was relatively low (4.7 fish per 100 feet), but steelhead density was also low. Juvenile coho on Gazos Creek were present at all sites downstream of the bedrock chutes at the Mountain Camp, and overall density (27.7 fish per 100 feet) was more than 4 times that of 1999, the year with the previous highest density.

Steelhead abundance in Gazos Creek was similar to previous years, despite the presence of abundant coho. At most habitats sampled in both 2001 and 2002 coho abundance did not appear to affect young of year (YOY) steelhead abundance. YOY steelhead abundance on sampled habitats on Scott Creek was less than half that of coho, and was similar to the low abundances found for 1993 and 1996 year classes, when coho were also abundant. High coho abundance appears to suppress steelhead on Scott Creek, except possibly in wet years (1999). Waddell Creek steelhead were at less than half strength for the fourth year in a row. Site densities were also at less than half of previous means throughout the watershed. Low densities in 1999 and 2000 were mostly restricted to sites downstream of the forks, where the loss of salmonids and sculpins appeared to be due to a toxic kill. However, the general scarcity in 2001 and 2002 may (also) be due to few returning adults, due to poor production in 1999 and 2000 and/or poor between-storm passage at a logjam immediately upstream of the lagoon.

Fall sampling of juveniles has been a relatively low effort means of assessing status of coho and steelhead in these streams. Mortality among captured fish has been less than 2%, and the population impact of sampling 5-10 % of the habitat has been negligible.

INTRODUCTION

Since all wild female southern coho (*Oncorhynchus kisutch*) spend one year in the stream and two years in the ocean prior to spawning (Shapovalov and Taft 1954), at least 3 years of study are necessary to determine the status of the three numerically independent year classes. This report presents the results of the eleventh consecutive year of sampling for juvenile coho and steelhead (*O. mykiss*) on Scott, Waddell and Gazos creeks. The previous 3 cycles of juvenile sampling have demonstrated the importance of winter weather upon coho abundance, by affecting access or destroying redds (nests) (Smith 1998c and 2001). In the 2001-2 winter large storms were concentrated in November and December, and the remainder of the winter was quite mild. Such conditions should allow adult access to all parts of the watershed early in the spawning season and prevent their redds from being damaged by later scouring flows. In addition, returning adults (at least females) were from the 1999 year class, the only common year class south of San Francisco. Therefore, the 2002 sampling was undertaken to assess the potential for juvenile coho production in a year of ideal conditions for coho spawning success.

METHODS

In September and October 2001 all fourteen previously sampled Scott Creek watershed sites were sampled by electrofishing (Table 1). In September and October thirteen previously sampled sites on Waddell Creek were sampled (Table 2). Included were two sites on the upper west fork and one site on the upper east fork that had not been sampled since 1997 because of difficult access. In September nine previously sampled sites on Gazos Creek were sampled (Table 3). In addition, sampling was extended to pools within the steep bedrock channel near the Mountain Camp (above mile 5.45) and to a site only 0.2 miles upstream of Highway 1.

At sampled sites on each stream the same habitats were sampled as in previous years if possible. The length of stream sampled per site was similar to previous efforts, but total sampling length was generally somewhat higher than previous years (Table 4). The relative abundance of sampled habitats was generally similar to previous years, but also reflected the increase in pool abundance that occurred with scour and wood input during1998 El Nino storms (Table 4) (Smith 1998a).

The primary goal of the sampling by electrofisher was to look for the presence and abundance of coho, so sampling since 1992 has concentrated on pool and glide habitats, and riffles were seldom sampled. At each site usually 3 to 5 individual habitat "units" (a glide or pool, with its contiguous glide and run habitat) were blocknetted and sampled by 2 to 3 passes with a backpack electrofisher (Smith-Root Type 7, smooth pulse). Sampled habitats were representative of those available, except for Waddell Creek, where scarce large, deep pools on the main stem could not be sampled by electrofishing. Length, width, depth, cover (escape and overhead), and substrate conditions were determined, and percentage of habitat types assigned for each sample unit. Rosgen channel types were determined, and relative abundance of pool, glide, run and riffle habitat types estimated for the vicinity of each site (Tables 1-3).

Juvenile fish were measured (standard length, SL) in 5 mm increments, and young-of-year (YOY) steelhead were separated from older fish based upon length-frequency at each site. Mortality was kept to a minimum by reducing electrofisher voltage (400-200 V) in shallow water and by immediately placing captured fish in a floating live car. Mortality was recorded at the time of length measurements.

RESULTS AND DISCUSSION

Habitat Conditions in 2002

Winter flows in 2001/2002 reached approximately bankfull stage on Scott and Gazos creeks and the west fork Waddell Creek, and were somewhat higher on the east fork of Waddell Creek. Individual habitats were modified at about 1/3 of the sample sites. However, no significant overall changes in channel configuration or pool frequency, depth or complexity occurred in 2002 on any of the 3 streams. Almost no new wood was added in 2002.

On all three streams substantial wood was added in 1998 (Smith 1998c), and large wood was reworked during large storms in 1999 and 2000. However, little was added over the last 4 winters or during the 1992-1997 period. Large wood additions, especially from long-lasting conifers, apparently occur episodically only during extremely wet years, when numerous landslides deliver upslope trees to the channel, and large floods erode stream banks and topple large riparian trees. Some smaller streamside alders are added to the channel in most average or wet years, but they easily rearrange and break up quickly; habitat benefits, although important, are smaller and of rather brief duration.

Winter storms ceased early in 2002 and stream flows declined quickly in spring. However, the summer was relatively cool. After the quick early decline, stream flows declined much more slowly and were not especially low in September.

The amount of fine sediment present in late summer appears to have increased in Waddell and Scott creeks in recent years. Streambed and bank rooting by feral pigs has substantially increased in the last 4 years, and is probably a major factor in the increase in fine sediment. On the upper portion of West Fork Waddell Creek streamside hog wallows and bank damage were especially common in 2002.

A large logjam was created in 1998 on Gazos Creek about 0.4 miles upstream of Old Woman Creek. Although the jam was more than 40 feet long and spanned the channel, it did not appear to be a problem for fish passage from 1999 through 2002. Passage under the jam was possible due to scour of the sand and fine gravels of the streambed. In addition, storms in December 2002 removed much of the wood near the right bank and scoured a larger channel under the jam. Another smaller jam was located 0.1 miles upstream of Old Woman Creek in 1998. In 1999 the jam was reduced and migrated slightly downstream. In 2001/2002 the wood from the jam again moved and formed a new jam under the bridge immediately upstream of Old Woman Creek. The jam was not a fish passage barrier in 2001/2002 and was removed by mid-December storms in 2002.

On Waddell Creek a partial logjam formed in 1996 at a fallen cottonwood immediately upstream of the lagoon, and the jam was substantially enlarged and spanned the channel in 1998. Easy fish passage was possible under or through the left side of the jam through 1999, but the jam was increasingly solidified by accumulations of wood in 2000 through 2002. The jam is now 35-60+ feet long and up to 6+ feet high. The jam still appears passable during floods, when portions appear to float and when scour in the sandy streambed under the jam opens pathways. However, the jam may cause passage problems in the lower flows between storms when the jam settles to the streambed. In winters like 2000-2001 and 2001-2002 rain and streamflow declined early in late winter and spring and may have caused passage problems for the later half of the adult steelhead run. Another logjam on the West Fork probably formed in 1998 at a landslide 1/3 mile downstream of Buck Creek. In November 2002, the jam spanned the channel and was 50+ feet long and up to 6 feet high. The logjam now appears to prevent adult passage, except during floods, to about 1 mile of habitat between the jam and Slippery Falls.

Coho

Scott Creek Watershed. Juvenile coho were captured at all 14 sites sampled in 2002 (Table 1), and overall density (79.2 per 100 feet) was about 2 ½ times the previous high densities of 1993, 1996 and 1999 (27.2-33.0) (Table 4). At each of the 14 sites the coho density in 2002 was higher than all previous sample years (Table 6). At all sites except the two on upper Big Creek juvenile coho even outnumbered juvenile steelhead in the predominately pool and glide habitat sampled in 2002 (Tables 1 and 7). The only site where coho were relatively scarce (13 per 100 feet) was on upper Big Creek, where step runs and bedrock pools dominated the steep, entrenched channel (Rosgen B3).

In two previous strong coho years (1993 and 1999) coho densities were relatively low in Big Creek and on Scott Creek downstream of Big Creek (Table 6). A similar effect on lower Scott Creek may have been masked in 1996 by stocking of coho fry downstream of Big Creek. Big Creek is a relatively steep stream with a large funnel-shaped watershed that generates large flood flows. Unless mid-winter through spring streamflows are mild, it's likely that coho redds and fry will destroyed in Big Creek and on Scott Creek downstream of Big Creek. In 1995 and 1997, when coho were only moderately common, they were scarce or absent on Big Creek and on Scott Creek downstream of Big Creek. They were also apparently nearly eliminated from sites 9 – 11A on upper Scott Creek in both years and in Mill Creek in 1997 (Table 6). It appears that the core coho habitat in most wet years is the flatter (< 2% gradient) less flood-prone reach on Scott Creek between Big Creek (mile 2.15) and about mile 5 and also possibly on Mill Creek.

A single February flood in 1992 and several February and March floods in 1998 produced extremely weak year classes (Table 4). In 1992 coho were very scarce except at one site where spawning apparently occurred after the storm (Table 6). In 1998, adults were common but juvenile coho were scarce throughout the watershed; apparently all redds suffered damage from the frequent large storms (Table 6). The 2000 and 2001 year classes on Scott Creek were

extremely weak (Table 4), due to the carryover effects of past flood and drought years (Smith 2001a and 2001b).

Within sites where coho have been collected in the past, their habitat use has varied substantially with their overall abundance. In weak years juvenile coho in Scott Creek were captured almost exclusively in their preferred habitat of deeper and/or complex pools. However, in 2002, as in previous strong coho years, juvenile coho expanded their habitat use to include all habitats except riffles. Highest density, and highest relative abundance compared to YOY steelhead, was in deeper pools, but even shallow pools and glides with good escape cover had high coho densities if streamflow and velocities were low. Where streamflows were higher (Big Creek and Scott Creek downstream of Big Creek) coho were scarce or absent in faster run and glide habitats.

As in previous years, Scott Creek coho averaged somewhat larger than YOY steelhead at the same site (Figure 1), reflecting earlier spawning and emergence by coho. However, the difference between the two species was less in 2002, and both species tended to be smaller in 2002 (Figure 1). The decline in growth apparently reflects extreme scramble competition for food due to the high coho abundance in 2002. Since coho were smaller than in previous years, the extremely high juvenile densities seen in Fall 2002 may not translate into proportional smolt or adult production, because of lower overwinter survival (especially if 2002-2003 is very wet), smaller smolt size and lower ocean survival.

As in previous years coho (and steelhead) sizes tended to increase from upstream to downstream (Figure 1). This increase in size downstream may be due to earlier emergence downstream (due to warmer water), more algal and insect production with slightly less shading downstream and/or to higher streamflow downstream of Big Creek.

Waddell Creek Watershed. Juvenile coho were relatively uncommon and largely restricted to the West Fork in 1999 (Smith 1999), so their scarcity compared to coho abundance in Scott and Gazos creeks in 2002 is not surprising. All fish (including the sculpins, *Cottus asper* and *C. aleuticus*) were scarce downstream of the confluence of the east and west forks in 1999, apparently due to a toxic fish kill (Smith 1999). In 2002 both steelhead and coho were still relatively scarce within the watershed, but coho were more widespread than in 1999 (Table 2). Highest densities were still on the West Fork, but it appears that successful spawning also took place on the lower portion of the East Fork and on the main stem near Twin Redwoods Camp (Table 2). Overall density was only 4.7 coho per 100 feet of sampled stream, and the highest site densities were only 6.8-18 coho per 100 feet on the West Fork and at Twin Redwoods Camp. The overall density was somewhat higher than in 1999 (3.1), but still substantially below the highest recorded density (12.5) of 1996, when production on the main stem was augmented by stocking of fry from the Big Creek Hatchery (Table 4). Not only was the 2002 coho year class not very strong, it is the only viable year class for the watershed. The 2000 year class was absent and the 2001 year class was very weak (0.5 per 100 feet) (Table 4), due to the impacts of past flood and drought years (Smith 2001a and 2001b).

Except in 1996, most juvenile coho have been captured on the West Fork upstream to Slippery Falls and also immediately downstream of the confluence (Smith 1992-1999; Smith and Davis 1993). The East Fork is steeper and has a watershed more prone to extreme floods; it appears

to provide suitable coho habitat upstream to Last Chance Creek only after milder winters (1993, 1996). Substrate is sandy on much of the main stem, and early spawning coho do not appear to be very successful there, especially if flooding has occurred on the East Fork. Coho also spawned in Henry Creek in 1992, 1993 and 1996, but no coho were captured there in 2002. As would be expected with the low coho densities, captured fish came primarily from pools with good escape cover, such as undercut banks.

As in previous years, coho on the West Fork were larger than YOY steelhead (Figure 2). YOY steelhead on the main stem were larger than on the West Fork (Figure 2), as in most years. However, coho on the warmer main stem were no larger than on the West Fork, and were generally smaller than the steelhead. Although scarce compared to coho on Scott Creek, Waddell Creek coho were similar in size to those from 1999 (Figure 2) and larger than Scott Creek coho from 2002 and from 1999 (Figures 1 & 2). Hopefully the larger size will be reflected in greater overwinter survival, larger smolt size and higher ocean survival.

Gazos Creek. Several juvenile coho were captured at the bedrock pool at the base of the chutes near the Mountain Camp (mile 5.45), but coho were absent from pools within the chutes (Table 3). Otherwise they were captured at all sites in 2002, with an overall density of 27.7 fish per 100 feet of sampled habitat. This amounted to a quadrupling of coho density compared to 1999 (6.2 per 100 feet) (Table 4). Densities were lowest downstream of Old Woman Creek (8-22 fish per 100 feet), where they have rarely been captured in previous years (Smith 1992-2001). Old Woman Creek is a continuing source of fine streambed sediment and spring turbidity for the lower portion of Gazos Creek

In 1996, juvenile coho upstream of Old Woman Creek were augmented with fry from the Big Creek Hatchery (Smith 1996b). Otherwise coho have been common only upstream of about mile 4 (Smith 1994, 1999). In 1999 coho were as abundant as in 2002 (28 per 100 feet) only at site 7A, at mile 5.3 (Smith 1999). However, they were also reasonably common (10-13 per 100 feet) at the sites at miles 4.4 to 4.85. Substrate in Gazos Creek is generally fine and light (low-density mudstone), and the streambed is relatively mobile. The restriction of coho to upstream sites in most years appears to be because of coarser spawning substrate and higher frequency of bedrock outcrops and large logs that serve as stream gradient controls. The abundance of rearing coho throughout the stream following the lack of mid winter to spring floods in 2002 demonstrates that spawning success controls Gazos Creek coho abundance. The unusual strength of the 2002 year class should be tempered by the lack of 2000 and 2001 year classes (Table 4), apparently due to past flood and drought impacts (Smith 2001a and 2001b).

Within sites coho have been found primarily in complex pools in the past. In 2002 they were most abundant in pools, but they expanded their habitat use to include everything except riffles and fast runs. Coho were generally somewhat bigger than YOY steelhead at the same site (Figure 3), and sizes generally increased downstream. Coho were smaller in 2002 than in 1999 (Figure 3) and similar in size to those of Scott Creek from 2002 (Figures 1 and 3). The smaller coho size in 2002 was apparently due to the much higher densities and more intense intraspecific competition in 2002 and/or to the higher summer streamflows in 1999.

Steelhead

Scott Creek Watershed. YOY steelhead abundance in the Scott Creek watershed (35 per 100 feet) was relatively low compared to previous years (Table 5), but similar to two previous years of abundant coho, 1993 and 1996 (35-39 per 100 feet). Highest steelhead YOY densities were on two upper Big Creek sites (58-67 per 100 feet), where coho were relatively scarce, and on Mill Creek (54 per 100 feet) (Table 1). When only the same, unchanged habitat units were compared between 2001 and 2002, YOY steelhead density was reduced 42 percent compared to 2001 (Table 7). Reductions in steelhead at 9 of 12 sites ranged from 21 to 88 percent in the face of very high pool and glide coho densities. Two sites showed small steelhead increases (5-6 percent), and the only site with a substantial increase (site 11) had extremely low densities in 2001. However, although YOY steelhead were reduced by about 20 fish per 100 feet, the increase in coho was more than 74 fish per 100 feet (Table 7). Although coho appeared to suppress steelhead abundance in 2002, there was a gain of almost 4 coho for each steelhead lost, indicating that the competitive impact of coho on steelhead was substantially less than that of intraspecific competition among steelhead. However, in 1993, 1996 and 1999 steelhead abundance was cut by about half compared to the preceding sample years (losses of 50-55 YOY steelhead) (Table 5). Steelhead abundance in 1993 and 1996 was similar to that of 2002, despite coho increases of only 27 to 33 fish per 100 feet (Tables 4 and 5). In 1999, which had high spring and summer streamflows, YOY steelhead were still common (62 per foot) despite the sharp decline compared to the previous year. The results among years may indicate that moderate to high abundance of coho is sufficient to impact steelhead use or survival in much of the pool and glide habitat, although steelhead are still able to dominate faster water in runs and at the heads and tails of pools and glides. Differences in habitat use or behavior among different habitats and among years with different habitat conditions (streamflow, food availability, water temperature, etc.) appear to be factors in the outcome of the interaction between YOY coho and steelhead.

Both steelhead and coho were smaller than in 2001 and also than in 1999, when coho were moderately abundant (Figure 1), apparently reflecting "scramble" sharing of scarce food in the sampled pools and glides. YOY steelhead increased in size from upstream (Upper Scott and Mill creeks) to downstream in 2002 (Figure 1). YOY steelhead sizes have normally varied among sites, with fish at the two Scott Creek sites downstream of Big Creek being larger than at sites upstream of Big Creek, where stream flows are much lower (Smith 2001b). In addition, shaded low flow sites on upper Scott Creek and on Mill Creek have tended to have smaller fish than other Scott Creek and Big Creek sites (Smith 2001b). All but the heavily shaded upstream sites have had bigger fish in very wet years (1995 and 1998), but otherwise sizes have changed little with summer streamflow in this relatively dry watershed (Smith 2001b). Presumably this is because streamflows have usually declined substantially before many steelhead have emerged. At heavily shaded upstream sites emergence is usually after flows have substantially declined, so flow during the growing season varies little among years.

Yearling steelhead on Scott Creek were relatively scarce in 2002 (Table 5). Low yearling abundance could be due to poor overwinter survival and/or to improved spring growth resulting in smolting by yearlings. The early storms and mild winter and spring in 2001/2002 should have provided ideal conditions (clear water) for yearling growth in late winter and spring; presumably many yearlings reached larger size by April and May and smolted.

Waddell Creek Watershed. For the fourth year in a row overall steelhead density on Waddell Creek was very low, averaging only 23 fish per 100 feet in 2002 and 28-33 in the previous 3 years (Tables 2 and 5). In all four years densities downstream of the forks were extremely depressed (Tables 2 and 8), with YOY site densities at least 20 % percent below previous low years and 40 % below the 1995-98 means. The only exception was in 2002 at the Twin Redwoods Camp site, where density was within the range of 1995-98 results. The most dramatic results were in 1999 when YOY steelhead densities were reduced more than 80-90 percent from the middle of Camp Herbert downstream, but "normal" from the middle of Camp Herbert upstream on the main stem and on both forks. In 2000, densities on the main stem were somewhat better, but still 58-88 % below the 1995-98 means. In both 2001 and 2002 the 3 sites immediately downstream of the forks had densities of less than 1-13 % of 1995-98 means. In addition, densities were substantially depressed at 3 East and West Fork sites in each year (Tables 2 and 8).

The effects observed in 1999 and 2000 appear as if there was a toxic fish kill extending from Camp Herbert downstream. The 2001 and 2002 results show a widening of the density depressions within the watershed. The apparent declines at these additional sites may be due to impacts similar to those affecting main stem sites and/or may reflect low adult numbers in 2001 and 2002 due to poor juvenile production in 1999 and 2000. The relatively normal abundance at the Twin Redwoods Camp site on the main stem in 2002 suggests that a widespread fish kill on the main stem was not responsible for the low 2002 densities. However, evidence of several redds was present at site 5, ½ mile downstream of the confluence of the forks, but steelhead density was very low (Tables 2 and 8). Additionally, the logjam immediately upstream of the lagoon appears to present passage problems between storms. This could have reduced steelhead adult access and spawning success in 2002, especially if adult numbers were already depressed due to poor juvenile production in 1999 and 2000.

Overall yearling densities for the last 4 years have been impacted less than that of YOY, but still have been only about half of those seen in 1997 and 1998 (Table 5)

The loss of YOY steelhead from the main stem has even greater potential impact than the density declines indicate. Main stem steelhead have regularly grown much faster than those in the forks (Smith 1998c and Figure 2), resulting in smolting of many of the fish as yearlings. In addition, if the apparent fish kills extended to the lagoon, as appears likely in at least 1999, that would result in a substantial loss of potential smolts, as the lagoon normally produces numerous, very fast growing steelhead (Smith and Davis 1993; Smith 1996b and 1997).

Gazos Creek. YOY steelhead density in Gazos Creek in 2002 was higher (49 per 100 feet) than the 1992-2001 mean (43) and also higher than in 2001 (45)(Table 5). The increase can be accounted for by the recovery of steelhead numbers at two upstream sites (sites 5 and 7A), which had unusually low abundance in 2001 (Smith 2001b). As in previous years, densities were relatively low downstream of Old Woman Creek (Table 3), where turbidity and fine sediment appear to be a problem in many years (Smith 1996 and 1998c).

Of special interest was that the slight increase in steelhead abundance occurred despite the presence of abundant coho (27.7 per foot) (Table 3). When the 2001 and 2002 densities of identical habitats at the lower 7 seven sites were compared, YOY steelhead overall abundance had declined less than 1 fish per 100 feet, despite a 28.2 fish per 100 feet increase in coho (Table 9). Steelhead actually increased substantially (19-76%) at the lower 4 sites despite the increase in coho. These results contrast with Scott Creek where abundant coho cut YOY steelhead densities in 1993, 1996, 2002 and possibly 1999. Summer streamflow in Gazos Creek is consistently high compared to Scott Creek upstream of Big Creek, so velocity-based segregation of the two species may be more possible on Gazos Creek. Alternatively, habitat conditions (such as substrate quality) downstream of mile 3 may have substantially improved in 2002, increasing spawning or rearing success for YOY steelhead in the lower portion of the creek.

On Gazos Creek there has usually been a gradual increase in YOY steelhead size between sites 1 (channel mile 0.9) and 3 or 4 (3.15 or 4.4 miles) and little change further upstream (Figure 3 and Smith 2001b). The size gradient may reflect warmer water and earlier fry emergence downstream. YOY steelhead sizes within sites have varied somewhat among years, with no readily identifiable relationship to summer streamflow. In 2000 YOY steelhead were less common (Table 5) and larger than average (Smith 2001a). In 2001 and 2002 summer streamflow, YOY steelhead densities and steelhead sizes were similar, despite the absence of coho in 2001 and their abundance in 2002.

As seen in Scott Creek, yearling steelhead densities in Gazos Creek were relatively low in 1997-2000 (Table 5), years of heavy winter storms. However, yearling abundance was even lower in 2002, after a winter of only early large (bankfull) storms. Spring growth for yearlings may have been especially good in 2002 due to the mild spring conditions, resulting in a higher incidence of smolting by yearling steelhead.

MANAGEMENT IMPLICATIONS

Coho

Although juvenile coho were very abundant in 2002, previous surveys of Scott and Waddell creeks (Santa Cruz County), Gazos Creek (San Mateo County), and Redwood Creek (Marin County) in 1988 and 1992-2002 have shown wide year to year variation in coho abundance within streams (Smith 1992–2001; Smith and Davis 1993). No coho were captured in 1994, 1997 and 2000 in Waddell Creek and in 1997, 2000 and 2001 in Gazos Creek. Coho were very rare in Waddell Creek in 1992, 1995, 1998 and 2001, Gazos Creek in 1992, 1995 and 1998, and in Scott Creek in 1992, 1994, 1998, 2000, and 2001 (Table 4). Coho abundance in Scott Creek had rebounded in 1995 and 1997 due to spawning by precocial (2-year old) hatchery-reared females (Smith 1995b and 1998a). However, the 1998 El Nino nearly eliminated the 1997 year class (due to poor overwinter or early ocean survival) and the 1998 year class (due to destruction of redds); the 2000 and 2001 year classes were extremely weak as a result. Similar situations occur elsewhere on the central coast, including Redwood Creek in Marin County, where the 1988, 1994 and 2000 year classes were less than 5-10 percent as abundant as other

year classes (Smith 2000). These wide coho coho abundance differences occur because the restricted spawning period, single spawning attempt and rigid ages of smolting and spawning (Shapovalov and Taft 1954) make spawning success susceptable to drought, floods or other "disasters" within small watersheds (Smith 1994c). Steelhead, however, have extended spawning periods, can spawn more than once and are variable in their ages of smolting and maturation (Shapovalov and Taft 1954). Therefore, steelhead juvenile abundance is more likely to indicate yearly rearing habitat quality. In addition, their populations are less affected by, and recover quickly from, bad years. Steelhead juvenile numbers in the same streams have been quite stable (Table 5).

The situation for coho in these three streams is somewhat worse than, but similar to, that of 1992-1994. Only a single strong year class is present (the 1993,1996,1999, 2002 year class). The other 2 year classes are either gone (2000 and 2001 year classes for Gazos Creek and 2000 year class for Waddell Creek) or very weak (2000 and 2001 year classes for Scott Creek and the 2001 and 2002 year classes for Waddell Creek). The single strong year class (1993) on Scott in the earlier period was able to rebuild the other two because accelerated growth of hatchery-reared coho produced precocial (2-year old) spawning females. The role of hatchery rearing again appears crucial to rebuilding 3 viable year classes.

Alternatively, if overwintering survival of the single strong year class is crippled or eliminated by floods in winter 2002-3, or by other disasters in future years, coho will be essentially extirpated south of San Francisco Bay. Summer rearing conditions for coho are suitable in the 3 streams, which have cool, flat habitat. In addition, complex pools are frequent on Scott and Waddell creeks and common on Gazos Creek. However, drought in 1991, when adult access wasn't possible until March, and floods in 1992, 1995, 1997, 1998 and 2000, which destroyed many redds and reduced overwinter survival, have nearly eliminated coho. These drought and flood impacts apparently extend widely in central California, as Redwood Creek in Marin County also has one very weak year class (1988, 1994 and 2000) (Smith 2000). Most alarmingly, a single extreme winter, like 1998, may weaken or eliminate 2 year classes, by impacting overwintering juveniles and by also destroying redds.

Steelhead

Although also federally listed as threatened, steelhead in these streams appear to be doing well. Only the apparent fish kills on the main stem of Waddell Creek in 1999-2002 raise concern. Densities have fluctuated by only a factor of about 2 from year to year (Table 5), generally increasing in years of higher summer stream flow. Late-spawning steelhead have apparently not been impacted by floods as have coho. Fish at upstream shaded, low summer flow sites have generally been smaller than fish at downstream sites in Waddell and Scott creeks; Gazos Creek fish have been similar in size to upstream sites on the other two streams. Little size change in YOY fish has occurred between wet and dry years, except at downstream sites or with large summer flow increases or decreases. For most sites the strongest effect of summer stream flow appears to be on density, rather than on growth rate.

Monitoring

Fall monitoring of juveniles at representative, repeatable sites on the three streams has required about 200-250 man hours per year (using a 2-person sampling team) and has provided a valuable index to steelhead and coho status. Electrofishing is the only effective way to sample juveniles at many of the sites, because snorkeling would not be effective in shallow, small or complex habitats or at heavily shaded sites. Mortality from electrofishing has been low, averaging 0.6 % among captured steelhead and coho in four streams in 2002 (Table 10). Mortality in previous years has been similar, although it has exceeded 2 % in deeper, complex habitats or under warmer water conditions (Smith 1996-1999). In addition, since only 3-10 % of the habitat is sampled, the loss to the total stream population is less than 0.1%.

Trapping of adults or smolts on these streams would provide valuable abundance data for other important life history stages. However, it would also probably require very expensive weirs, and/or provide relatively inaccurate data. Trapping would be inefficient during much of the high-flow adult migration period and during the variable early portion of the smolt migration period. Past experience on Waddell Creek has indicated that much of the adult or smolt migrations occurs during high flow events, when simple trap systems fished poorly (Smith 1992).

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Table 1. Site locations, habitat types present and sampled, number of steelhead and coho collected and estimated density per 100 feet ( ) at sites on Scott Creek in September and October 2002. (Site #s agree with earlier reports).

Site	Mile >Hwy1	Chan Type	%Habitat Available PL	GL	RN	RF	% Habitat Sampled PL	GL	RN	RF	Sample Length (Feet)	#SHT +0	+1	Coho
A Near Diversion	0.9	C3	45	40	10	5	75	25	--	--	154	24 (18)	6 (4)	54 (38)
1 < Little Creek	1.9	C3	50	25	20	5	63	29	8	--	203	45 (27)	5 (2)	74 (44)
Big Creek	2.15													
2 Pullout > Big Creek	2.55	BC4	50	30	15	5	73	11	15	1	165	53 (33)	4 (2)	131 (82)
3 < Mill Creek	3.05	C4	50	30	15	5	86	14	--	--	142	34 (26)	4 (3)	108 (83)
4 < Swanton Road	3.55	BC4	50	30	15	5	61	29	10	--	122	37 (39)	12 (11)	175 (156)
5 Cattle guard	4.25	C4	45	35	15	5	54	46	--	--	184	30 (17)	11 (6)	240 (145)
7 Pullout < Big Cr. Gate	4.9	B4C	50	30	15	5	89	11	--	--	135	29 (24)	6 (6)	178 (144)
9 0.15 mile > bridge	5.15	B4C/F	45	25	20	10	73	17	10	--	103	38 (49)	2 (2)	97 (102)
11 Upper Ford	5.85	C3/4	50	30	15	5	86	9	5	--	219	39 (20)	8 (5)	98 (48)
11A 5th Trail Crossing	6.5	B3	45	10	35	10	76	18	6	--	173	37 (24)	8 (5)	98 (63)
12 Big Creek/ Swanton Road		C3	30	15	40	15	50	17	33	--	151	50 (36)	2 (1)	102 (72)
12A Big Creek < Hatchery		C3/B3	35	10	40	15	68	21	11	--	118	61 (58)	6 (5)	35 (31)
12B Big Creek > Berry Cr.		B3	40	10	35	15	64	11	25	--	136	82 (67)	9 (7)	18 (13)
13 Mill Creek <Swanton Road		C3	55	20	15	10	85	15	--	--	100	51 (54)	5 (5)	84 (88)

Table 1 (cont.)

Site	Mile >Hwy1	Chan Type	%Habitat Available PL	GL	RN	RF	% Habitat Sampled PL	GL	RN	RF	Sample Length (Feet)	#SHT +0	+1	Coho
Totals											2105	610	88	1492
Mean of 14 Sites			46	24	22	8	72	20	9	--		(35)	(5)	(79)

Table 2. Site locations, habitat types present and sampled, number of steelhead and coho collected and estimated density per 100 feet ( ) at sites on Waddell Creek in September and October 2002. (Site #s agree with earlier reports).

Site	Mile >Hwy1	Chan Type	%Habitat Available PL	GL	RN	RF	% Habitat Sampled PL	GL	RN	RF	Sample Length (Feet)	#SHT +0	+1	COHO
1 First bridge	0.6	B4C	50	30	15	5	75	12	13	--	187	26 (9)	--	--
2 < Alder Camp	1.35	B4C	50	35	10	5	65	28	8	--	199	42 (21)	12 (6)	6 (3.0)
3 Twin Redwoods	1.8	B4C	50	30	15	5	73	20	8	--	128	61 (53)	3 (3)	10 (10)
4 Periwinkle	2.2	C4	45	30	20	5	68	5	24	3	274	10 (4)	--	1 (0.4)
5 Pullout < Herbert	2.6	C3	55	25	15	5	73	6	15	6	165	12 (7)	3 (2)	1 (0.6)
6 Camp Herbert	3.1	B3C	50	25	15	10	91	--	9	--	233	12 (7)	3 (2)	--
7 E Fork > Ford	3.2	B3C	45	25	20	10	86	8	6	--	245	68 (30)	3 (1)	8 (4.0)
7A E. Fork	3.55	B3	40	15	35	10	71	--	29	--	124	30 (22)	4 (3)	--
8 W Fork	3.3	B4C	40	30	25	5	66	28	6	--	311	50 (20)	5 (2)	18 (6.8)
9 Mill Site	3.9	B4C	45	30	15	10	86	10	4	--	295	67 (26)	5 (2)	50 (18)
10 < Buck Cr.	4.7	B4C	40	30	20	10	77	13	10	--	239	71 (32)	2 (1)	19 (8.0)
11 < Henry Cr.	5.25	B1	45	15	30	10	100	--	--	--	168	26 (17)	3 (2)	17 (11)
13 Henry Cr. > trail	0.2	F1/4	40	30	20	10	68	32	--	--	125	40 (32)	5 (4)	--
Totals											2693	507	48	130
Mean of 13 Sites			45	27	20	8	77	12	10	1		(21)	(2)	(4.7)

Table 3. Site locations, habitat types present and sampled, number of steelhead and coho collected and estimated density per 100 feet ( ) at sites on Gazos Creek in September 2001. Site #s agree with earlier reports.

Site	Mile >Hwy1	Chan Type	%Habitat Available				% Habitat Sampled				Sample Length (Feet)	#SHT		COHO
			PL	GL	RN	RF	PL	GL	RN	RF		+0	+1	
A	0.25	C5	45	35	15	5	77	15	8	--	65	21 (33)	5 (8)	5 (8)
1	0.9	C5	40	30	20	10	83	16	1	--	204	61 (32)	7 (3)	33 (16)
2	1.8	C5	40	20	25	15	67	30	3	--	223	76 (36)	9 (4)	48 (22)
Old Woman Creek	2.05													
2A	2.1	C4	40	25	20	15	84	15	2	--	124	67 (60)	7 (6)	62 (55)
2B (G/H)	2.8	B4C	40	25	25	10	59	33	8	--	181	103 (68)	4 (2)	53 (33)
3 (<J)	3.15	B4C/F	40	25	25	10	55	23	14	8	124	81 (70)	5 (4)	29 (24)
3A (N)	3.9	B4C	40	30	20	10	88	12	--	--	173	75 (46)	4 (2)	67 (46)
4/4A	4.4/4.6	B4C	40	30	20	10	73	25	2	--	229	97 (48)	9 (4)	82 (39)
5	4.85	B4C	40	25	25	10	76	20	4	--	143	49 (37)	8 (6)	46 (33)
7A (>U)	5.3	B1	40	10	35	15	77	18	5	--	211	108 (55)	9 (4)	58 (29)
7B	5.45	B1/A1	40	5	30	25	100				149	75 (55)	14 (9)	1 (0.7)
Totals											1826	814	81	484
Mean of 11 Sites			40	24	24	12	76	18	4	2		(49)	(5)	(28)

Table 4. Number of sites, amount and type of habitat sampled, number of coho collected and estimated density (per 100 feet) for Scott, Waddell, Gazos and Redwood creeks in 1988 and 1992 – 2002.

Stream and Date		Number of Sites Sampled	Length (feet)	Habitat Percent PL	GL	RN	RF	% of Sites with Coho	# of Coho	Coho Density (/100')
Scott Creek										
Jul – Sep	1988	14	3535	41	25	21	12	84	384	15.5
Aug – Oct	1992	13	1624	66	30	4	0	46	42	4.3
Jan	1994	11	1554	49	32	19	0	100	376	27.2
Aug	1994	13	1744	59	36	6	0	46	17	1.1
Oct	1995	12	1686	59	32	8	1	92	223	14.2
Oct – Nov	1996	12	1684	62	30	8	1	100	473	33.0
Aug – Sep	1997	13	1865	64	24	11	0	62	145	9.3
Sep – Oct	1998	11	1753	77	16	6	1	64	34	1.8
Oct	1999	10	1430	81	17	2	0	90	328	29.2
Sep – Oct	2000	10	1810	81	13	6	0	40	7	0.4
Sep – Oct	2001	12	2024	80	18	2	0	33	12	0.6
Sep – Oct	2002	14	2105	72	20	9	0	100	1492	79.2
Waddell Creek										
Jun – Aug	1988	8	1817	54	19	23	5	63	19	1.3
Jul – Aug	1992	13	2858	67	31	2	0	38	19	0.6
Oct – Dec	1993	12	1857	38	21	28	14	75	58	3.6
July	1994	12	2367	66	24	7	2	0	0	0
Sep	1995	12	2498	64	24	10	2	58	24	1.1
Aug – Sep	1996	14	2491	69	21	8	2	93	302	12.5
Aug – Sep	1997	11	1873	58	32	8	1	0	0	0
Sep – Oct	1998	10	2083	76	18	5	1	20	7	0.3

Table 4 (continued)

Stream and Date	Number of Sites Sampled	Length (feet)	Habitat Percent PL	GL	RN	RF	% of Sites with Coho	# of Coho	Coho Density (/100')
Oct 1999	10	1558	78	19	4	0	40	66	3.1
Sep 2000	8	1511	65	19	13	3	0	0	0
Sep – Oct 2001	10	2234	81	14	2	3	20	13	0.5
Sep – Oct 2002	13	2693	77	12	10	1	69	130	4.7
Gazos Creek									
Aug 1992	2	275	44	56	0	0	0	0	0
Jan 1994	4	503	65	22	12	1	50	9	2.2
Nov 1995	4	425	58	19	21	3	25	1	0.2
Sep 1996	5	830	49	27	12	13	100	33	4.9
Aug 1997	5	827	45	28	17	10	0	0	0
Aug – Sep 1998	8	1529	65	14	11	10	25	10	0.4
Sep – Oct 1999	9	1475	79	18	2	1	67	79	6.2
Sep – Oct 2000	7	1036	75	15	10	0	0	0	0
Sep 2001	10	1791	77	21	2	0	0	0	0
Sep 2002	11	1826	76	19	4	1	100	484	27.7
Redwood Creek									
Jun – Sep 1992	4	1032	37	40	5	7	100	426	45.3
Jun – Aug 1993	4	951	48	25	18	9	100	355	46.3
July 1994	7	1287	58	25	12	6	43	24	1.9
Aug 1995	4	796	41	30	19	10	100	308	42.0
Nov 1996	3	604	51	31	11	7	100	214	38.8
Sep – Oct 1997	5	984	72	18	9	1	60	209	23.3
Oct 1998	5	1174	59	25	15	1	100	327	31.6

Table 4 (continued)

Stream and Date		Number of Sites Sampled	Length (feet)	Habitat Percent PL	GL	RN	RF	% of Sites with Coho	# of Coho	Coho Density (/100')
Oct	2000	6	1077	71	27	3	0	33	14	1.1
Oct	2001	5	956	78	15	0	7	60	242	26.8
Oct	2002	3	787	70	23	6	2	100	419	57.1

Table 5. Number of sites, amount and type of habitat sampled and estimated density (per 100 feet) of steelhead for Scott, Waddell, Gazos and Redwood Creeks in 1988 and 1992 – 2002.

Stream and Date	Number of Sites Sampled	Length (feet)	Habitat Percent PL	GL	RN	RF	Density Age 0+	Age ½+
Scott Creek								
Jul – Sep 1988	14	3535	41	25	21	12	57	7
Aug – Oct 1992	13	1624	66	30	4	0	89	2
Jan 1994	11	1554	49	32	19	0	39	21
Aug 1994	13	1744	59	36	6	0	52	18
Oct 1995	12	1686	59	32	8	1	90	10
Oct – Nov 1996	12	1684	62	30	8	1	35	20
Aug – Sep 1997	13	1865	64	24	11	0	68	7
Sep – Oct 1998	11	1753	77	16	6	1	113	10
Oct 1999	10	1430	81	17	2	0	62	10
Sep – Oct 2000	10	1810	81	13	6	0	78	7
Sep – Oct 2001	12	2024	80	18	20	0	52	8
Sep – Oct 2002	14	2105	72	20	9	0	35	5
Waddell Creek								
Jun – Aug 1988	8	1817	54	19	23	5	45	7
Jul – Aug 1992	13	2858	67	31	2	0	56	10
Oct – Dec 1993	12	1857	38	21	28	14	54	8
July 1994	12	2367	66	24	7	2	61	19
Sep 1995	12	2498	64	24	10	2	79	14
Aug – Sep 1996	14	2491	69	21	8	2	62	15
Aug – Sep 1997	11	1873	58	32	8	1	71	7
Sep – Oct 1998	10	2083	76	18	5	1	80	7

Table 5 (cont.)

Stream and Date	Number of Sites Sampled	Length (feet)	Habitat Percent PL	GL	RN	RF	Density Age 0+	Age ½+
Oct 1999	10	1558	78	19	4	0	27	4
Sep – Oct 2000	8	1511	65	19	13	3	30	3
Sep – Oct 2001	10	2234	81	14	2	3	24	4
Sep – Oct 2002	13	2693	77	12	10	1	21	2
Gazos Creek								
Aug 1992	2	275	44	56	0	0	24	12
Jan 1994	4	503	65	22	12	1	29	9
Nov 1995	4	425	58	19	21	3	68	14
Sep 1996	5	830	49	27	12	13	34	12
Aug 1997	5	827	45	28	17	10	36	8
Aug – Sep 1998	8	1529	65	14	11	10	53	7
Sep – Oct 1999	9	1475	79	18	2	1	51	8
Sep – Oct 2000	7	1036	75	15	10	0	37	6
Sep 2001	10	1791	77	21	2	+	45	11
Sep 2002	11	1826	76	19	4	1	49	5
Redwood Creek								
Jun – Sep 1992	4	1032	37	40	5	7	23	4
Jun – Aug 1993	4	951	48	25	18	9	56	4
Oct 1994	5	1018	83	10	4	3	34	6
Aug 1995	4	796	41	30	19	10	96	4
Nov 1996	3	604	51	31	11	7	33	11
Sep – Oct 1997	5	984	72	18	9	1	15	5

Table 5 (cont.)

Stream and Date		Number of Sites Sampled	Length (feet)	Habitat Percent PL	GL	RN	RF	Density Age 0+	Age ½+
Oct	1998	5	1174	59	25	15	1	47	4
Oct	2000	6	1077	71	27	3	0	39	15
Oct	2001	5	956	78	15	0	7	6	6
Oct	2002	3	787	70	23	6	2	11	3

Table 6. Sample site locations and coho densities (# / 100 feet) in the Scott Creek watershed in September 1992, January 1994 (1993 year class), October 1995, October and November 1996 (*augmented with fry), August and September 1997, October 1998 and 1999, September and October 2000, 2001 and 2002.

Site	Mile > Hwy 1	Year Class Density									
		1992	1993	1995	1996	1997	1998	1999	2000	2001	2002
A. Near Diversion	0.9		2	1	22*	0		5		3	38
1. at Little Creek	1.9	2	7	14	33*	0	0	6	0	2	44
2. >Big Cr.	2.55	0	31	29	31	30	1	35	1	1	82
3. < Mill Cr.	3.05	1		28		29	0		0	1	83
4 .< Swanton Road	3.55	0	86	26	37	20	3	45	0	0	156
5. Cattle Guard	4.25	0				11	2		1	0	145
7. Pullout < Big Cr. Gate	4.9	23	48	23	62	24	3	86	1	0	144
9. 0.15 mi > Bridge	5.15	1	39	12	62	1	0	45	0	0	102
11. Upper Ford	5.85	2	41	5	33	0	8	22	0	0	48
11A 5th Trail Crossing	6.5		16	3	31	1	3				63
12. Big Cr. Swanton Road		0	8	1	21	0	0	7	0	0	72
12A Big Cr. < Hatchery			9	0	30	0		0		0	31
12B Big Cr. > Berry Cr.					11			0			13
13. Mill Cr. < Swanton Rd.		0	12	28	24	6	0	42	1	0	88
Mean		4.3	27.2	14.2	33.0	9.3	1.8	29.2	0.4	0.6	79.2

Table 7. Comparison of estimated YOY steelhead and coho densities (#/100) at identical habitat units at sites on Scott Creek in 2001 when coho were very scarce and in 2002 when coho were abundant.

Site	2001 Len. (ft)	2001 Density Coho	2001 Density Steelhead	2002 Len. (ft)	2002 Density Coho	2002 Density Steelhead	Percent Steelhead Change
A. Near Diversion	153	3.5	22.6	154	37.5	17.8	- 21
1. At Little Cr.	162	2.4	41.7	172	47.8	26.8	- 36
2. > Big Creek	128	1.6	66.1	95	69.6	21.0	- 68
3. < Mill Creek	143	1.4	73.4	140	59.7	8.6	- 88
4. < Swanton Rd.	118	--	91.5	122	153.0	39.4	- 57
5. Cattle Guard	125	--	30.6	104	140.0	14.5	- 53
7. Pullout < Big Creek Gate	110	--	25.6	95	136.7	26.9	+ 5
9. 0.15 mi > Bridge	80	--	38.5	72	94.8	12.5	- 68
11. Upper Ford	188	--	16.9	222	47.7	23.6	+ 40
Big Cr. >Swanton Rd.	59	--	91.3	45	82.9	61.7	- 32
Big Cr. < Hatchery	85	--	56.1	118	31.0	59.2	+ 6
Mill Cr. < Swanton Rd.	81	--	55.0	77	82.9	42.4	- 28
Totals	1432	0.8	47.1	1416	75.0	27.2	- 42

Table 8. Densities of YOY steelhead (number per 100 feet) at sites on Waddell Creek in 1995-2002. In 1996 and 2002 coho were also common and those totals are included with the YOY steelhead for that year. (*Indicates values that are >20% below 1995-1998 low and also > 40% below 1995-1998 mean).

Site	Mile > Hwy 1	Year 1995	1996	1997	1998	95-98 Mean	1999	2000	2001	2002
13 Henry Cr. > Trail		56	34	81	--	57	--	--	--	32
11 < Henry Cr.	5.25	31	35	37	--	34	--	--	--	28
10 < Buck Cr.	4.7	74	54	74	45	57	39	--	42	40
9 Mill Site	3.9	47	60	53	51	53	44	--	20*	44
8 West Fork > confluence	3.3	53	42	51	60	60	36?	46	14*	27*
7 East Fork > confluence	3.2	76	43	49	115	71	67	51	21*	34*
14 East Fork Upstream		--	43	--	--	43	--	--	--	22*
6 Camp Herbert	3.1	128	51	42	81	76	57	9*	10*	7*
lower							7*			
5 Pullout < Camp Herbert	2.6	138	94	84	83	100	8*	23*	10*	8*
4 Periwinkle	2.2	139	150	108	123	130	9*	16*	1*	10*
3 Twin Redwoods Camp	1.8	69	81	92	53	74	9*	29*	27*	63
2 <Alder Camp	1.35	78	121	109	131	110	10*	46*	54*	24*
1 First Bridge	0.6	54	85	--	54	64	8*	18*	36*	9*

Table 9. Comparison of estimated YOY steelhead and coho densities (#/100) at identical habitat units at sites on Gazos Creek in 2001 when coho were absent and in 2002 when coho were common. Sites 5 and 7A are excluded because of unusually low steelhead densities in 2001.

Site	------2001--------		----------2002----------			Percent
	Len (ft)	Steelhead. Density	Len. (ft)	Density Coho	Steelhead	Steelhead Change
1. Mile 0.9	160	21.6	159	17.9	38.1	+ 76
2. Mile 1.8	108	26.7	117	24.4	31.9	+ 19
2A. Mile 2.1	70	43.2	60	58.8	65.2	+ 51
2B. Mile 2.8	84	48.4	96	23.5	58.0	+ 20
3. Mile 3.15	133	68.8	124	24.0	69.5	+ 1
3A. Mile 3.9	157	66.1	143	34.8	44.2	- 33
4. Mile 4.4	156	69.1	174	29.6	52.6	- 24
Totals	868	50.4	873	28.2	49.7	- 1

Table 10. Coho and steelhead killed and captured (/) by electrofishing and mortality rate (%) on Scott, Waddell, Gazos and Redwood creeks in September and October 2002.

	Steelhead				Coho	
	Age 0+		Age 1+		Age 0+	
	Kill/Capt	%	Kill/Capt	%	Kill/Capt	%
Scott Creek	6 / 610	1.0	0 / 88	0	8 / 1492	0.5
Waddell Creek	3 / 507	0.6	0 / 48	0	1 / 130	0.7
Gazos Creek	6 / 814	0.7	0 / 81	0	1 / 484	0.2
Redwood Creek	0 / 74	0	0 / 19	0	3 / 419	0.7
Totals	15 / 2005	0.7	0 / 236	0	13 / 2525	0.5
Overall			29 / 4766	0.6		

Figure 1. Standard lengths (mm) of coho and steelhead in 1999 and 2002 and steelhead in 2001 at sites on Scott Creek.

Mill Creek & Upper Scott Creek (sites 9 & 11)

	1999		2002		2001
	Coho	Steelhead	Coho	Steelhead	Steelhead
25 – 29				1	
30 – 34		2		*3	*3
35 – 39		*****15	****12	*****17	****14
40 – 44	2	****14	**********32	*******23	********24
45 – 49	***10	*******22	**********41	******20	**********38
50 – 54	******20	********26	**********33	**8	**********41
55 – 59	**********32	*****15	**********39	**7	******18
60 – 64	***10	***11	******20	**6	***10
65 – 69	*3	*5	**7	1	1
70 – 74	2	2		1	2
75 – 79	2				

Scott Creek Upstream of Big Creek (site 4)

	1999		2002		2001
	Coho	Steelhead	Coho	Steelhead	Steelhead
30 – 34			2	*5	1
35 – 39		*4	*5	*6	**8
40 – 44		**8	*****16	****13	****14
45 – 49		****12	*********27	****14	**********30
50 – 54	***10	*********27	**********35	**6	**********30
55 – 59	*********28	******18	**********30	*5	*****17
60 – 64	*****16	*****17	****12	2	****12
65 – 69	***9	**6	2		*5
70 – 74	***9	*3		2	*4
75 - 79					

Lower Big Creek and Scott Creek < Big Creek

	1999		2002		2001
	Coho	Steelhead	Coho	Steelhead	Steelhead
30 – 34					2
35 – 39				*3	*3
40 – 44		1	*4	**8	****12
45 – 49		*****17	******19	*****15	**********39
50 – 54	1	**********34	**********38	********24	**********45
55 – 59		**********31	**********52	*********27	**********47
60 – 64	*3	******20	**********58	******19	**********34
65 – 69	**6	****12	**********35	****13	**********31
70 – 74	***9	**8	******19	**7	*****15
75 – 79	**6	*3	**8	2	***9
80 – 84					**6
85 – 89			1		*3

Figure 2. Standard lengths (mm) of coho and YOY steelhead in 2002 and coho in 1999 from Waddell Creek.

	2002				1999
	West Fork (sites 8 – 11)		Main Stem (sites 2 & 3)		West Fork (sites 8 –10)
	Coho	Steelhead	Coho	Steelhead	Coho
30 – 34		2			
35 – 39		2			
40 – 44		***17			
45 – 49	**6	********44	1		2
50 – 54	***10	**********54	*3		*3
55 – 59	*****17	**********58	1	2	**8
60 – 64	******20	*****29	**6	****13	***11
65 – 69	********24	**13	*5	********24	*******21
70 – 74	*****15	***16	*3	****14	****13
75 – 79	***9	*5		****13	1
80 – 84	1	1		****13	1
85 – 89	1			***9	
90 – 94				***9	
95 – 99				*3	
100-104				*2	

Figure 3. Standard lengths (mm) of coho and YOY steelhead in 2002 and coho in 1999 from sites on Gazos Creek.

	2002						1999
	Site 1		Site 3		Site 5		Sites 4, 5 & 7A
	Coho	Steelhead	Coho	Steelhead	Coho	Steelhead	Coho
30 – 34				2		1	
35 – 39				****12		**7	
40 – 44		1		*******20	1	****14	
45 – 49		**7	1	*****15	****12	******18	2
50 – 54	2	****14	*****16	***9	****13	**6	*3
55 – 59	***11	******19	**7	*4	****12	*3	*******21
60 – 64	***10	***11	**6	**6	**6		******18
65 – 69	**6	*5	1	1	1	1	*******21
70 – 74	*3	2			1		*4
75 – 79	1	2					2
80 – 84		1					